Bibliothèque nationale de France (BnF)

Distributed
Archiving & Preservation System
Système de Préservation
et d'Archivage Réparti (SPAR)

The Storage Abstraction Service of the SPAR system

Workshop iRods

Agenda

- Objective and key requirements
- The global architecture
- The Storage Abstraction Service
- Implementation with iRods
- Conclusion

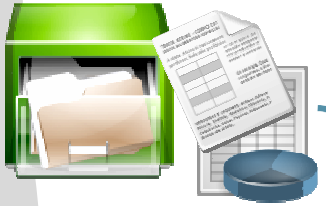
The National Library of France (BnF)

- Main missions:
  - → to build up the collections
  - → to preserve them forever
  - → to communicate them to the public
- Legal deposit:
  - → legal deposit since 1537 for printed materials
  - → 1648: engravings and maps
  - → 1793: musical scores
  - → 1925: photos
  - → 1938: phonograms
  - → 1941: posters
  - → 1975: videograms and multimedia documents
  - → 1992: audiovisual and electronic documents
  - → 2006: Web legal deposit

Digital archiving at BnF

Production applications

Preservation digitization



Record management

WEB Archiving

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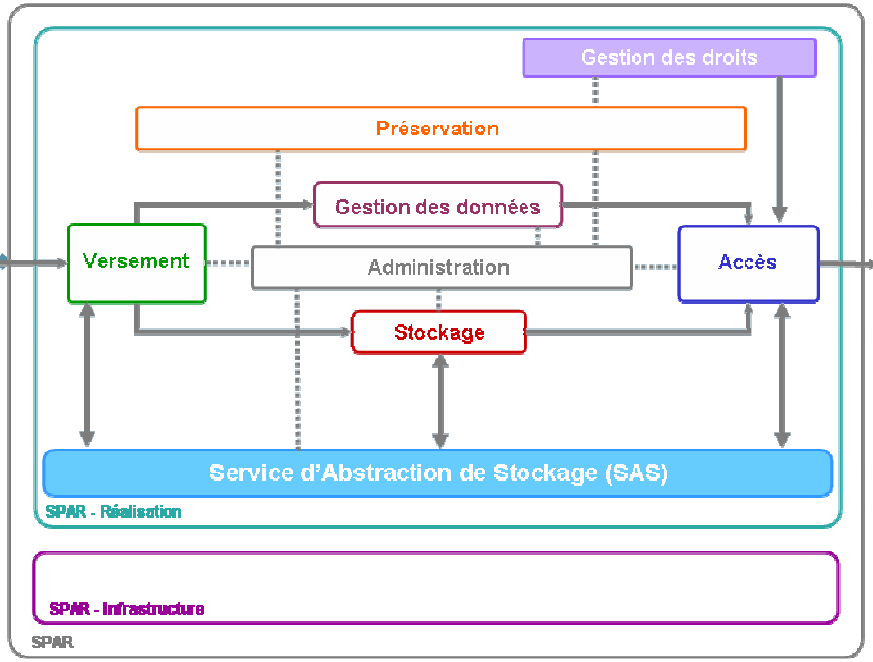

Dissemination applications

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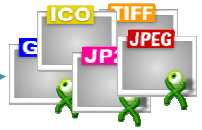

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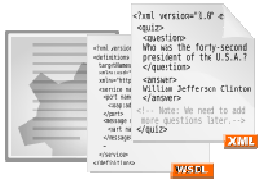

wayback

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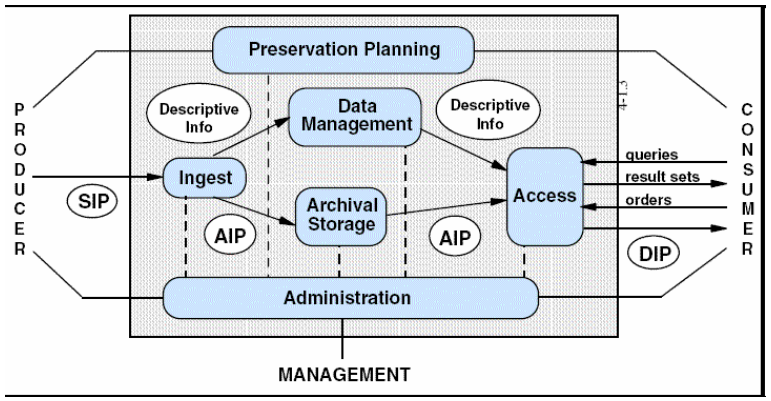
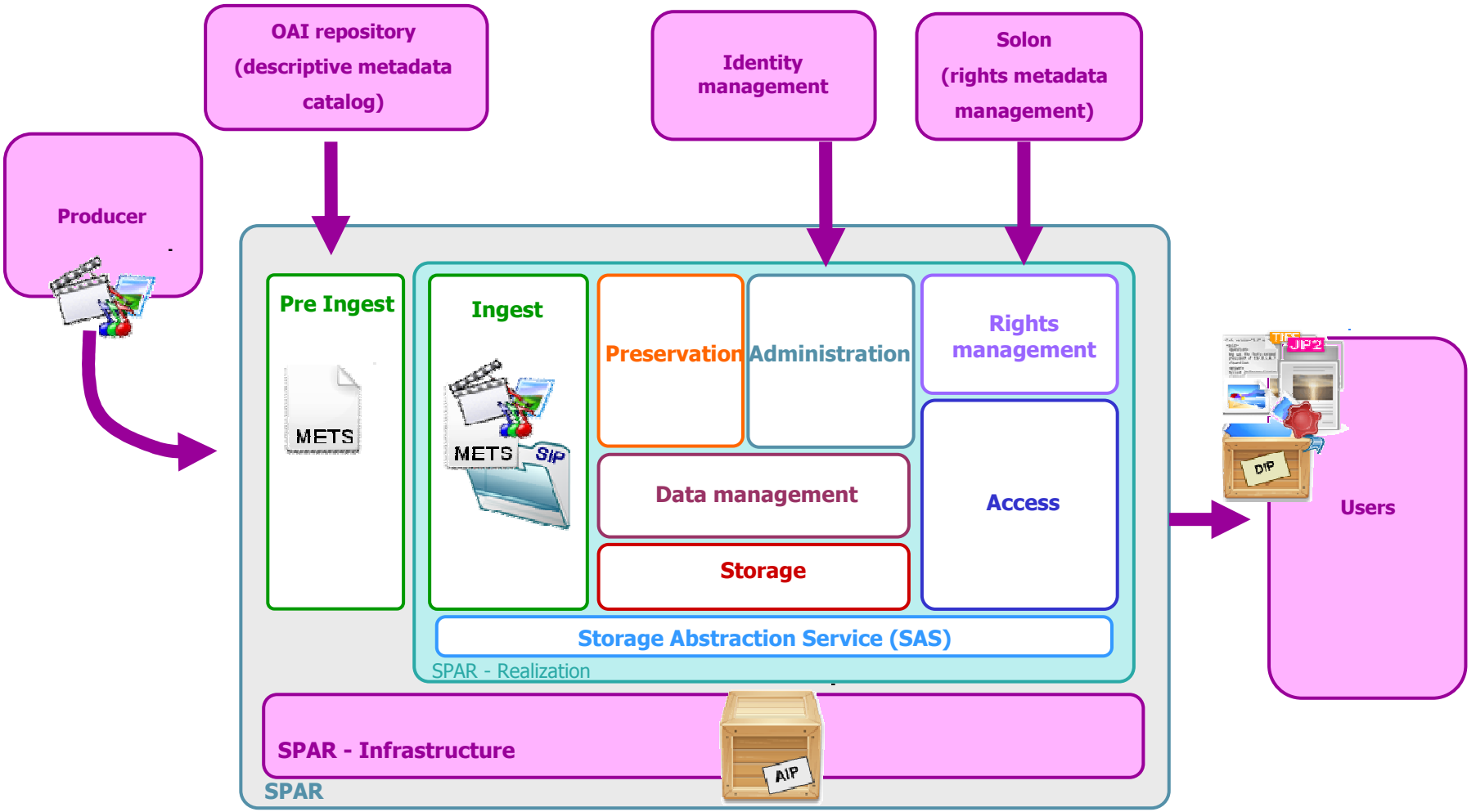
Key requirements

- OAIS compliance (ISO 14721:2003)
- modularity and distributivity
- abstraction
- use of well known formats and standards
- use of Open Source technical building blocks



Implementation



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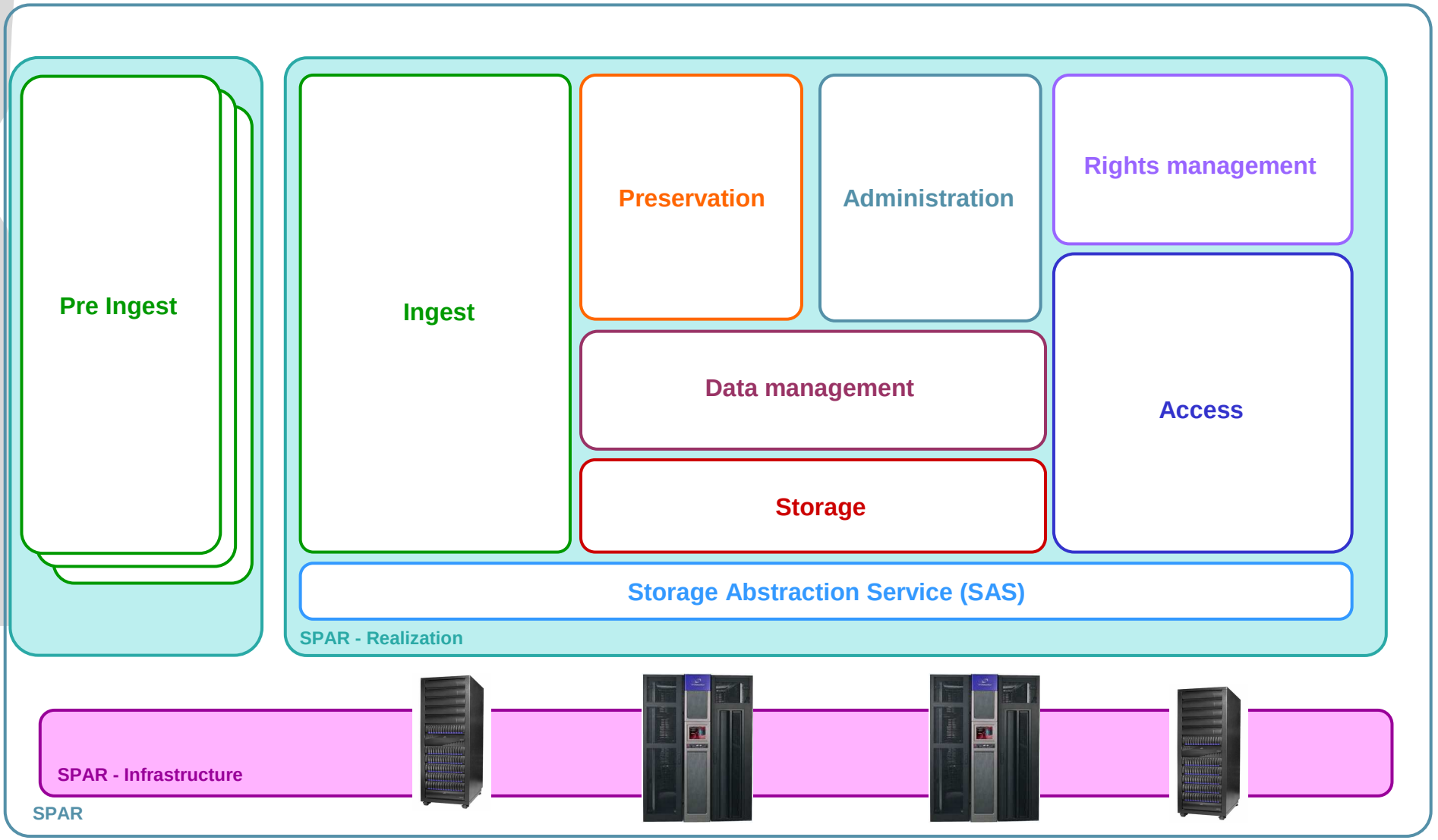
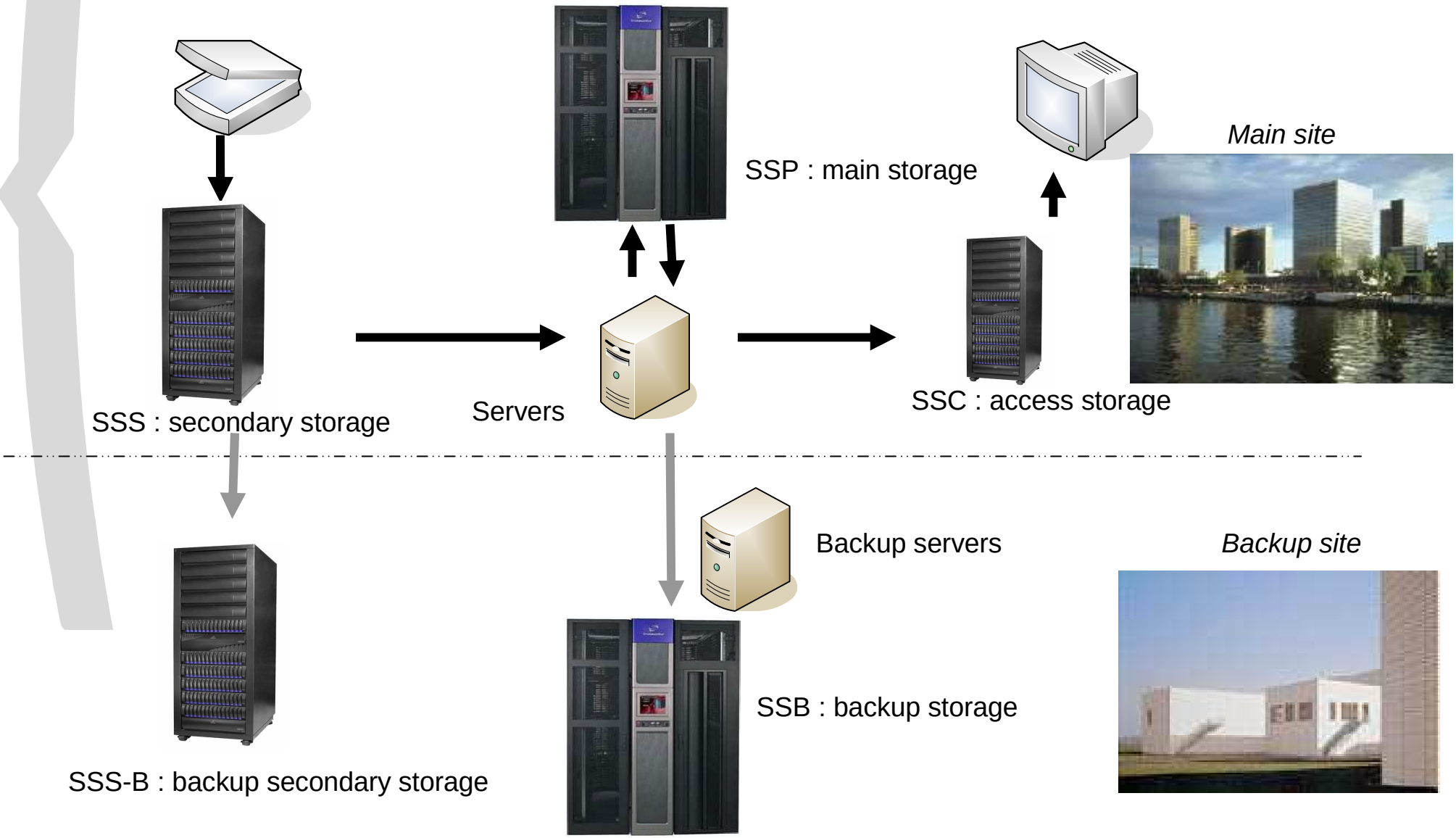
Modularity of SPAR



The infrastructure



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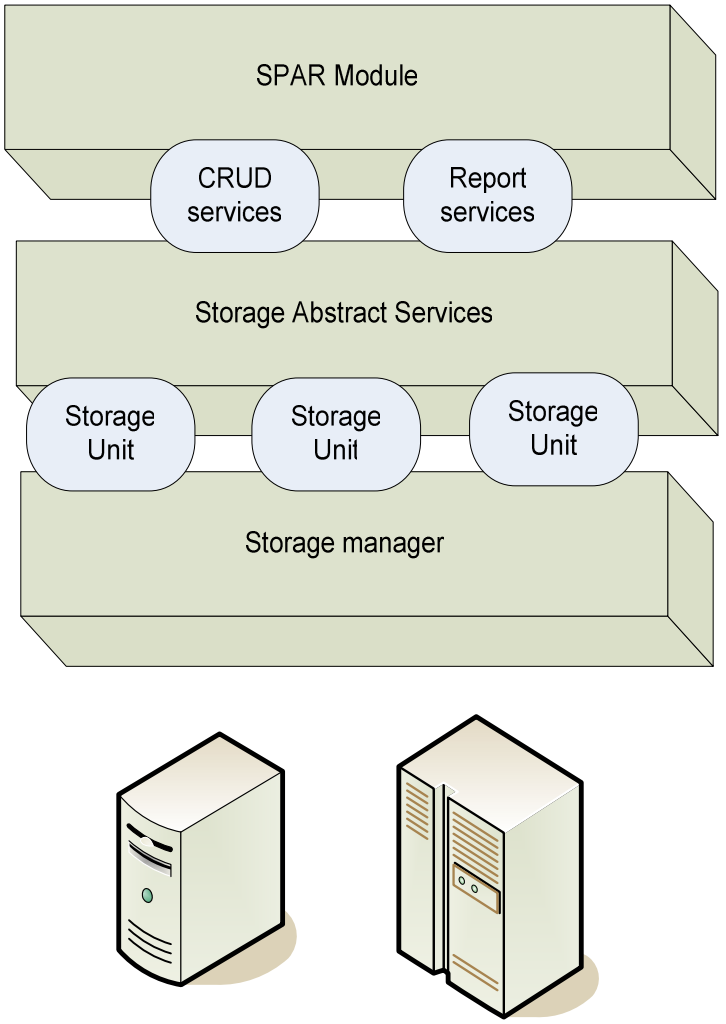
Requirements for the Storage abstraction service

- Abstract the infrastructure with:
  - → storage unit
    - ❖ aggregates storage element to defines an abstract storage defined by a class of service
      - – mean time (read/write)
      - – number of copies …
  - → record
    - ❖ simple bit stream (no semantics)
    - ❖ some properties : checksum, logical name, lastAuditDate



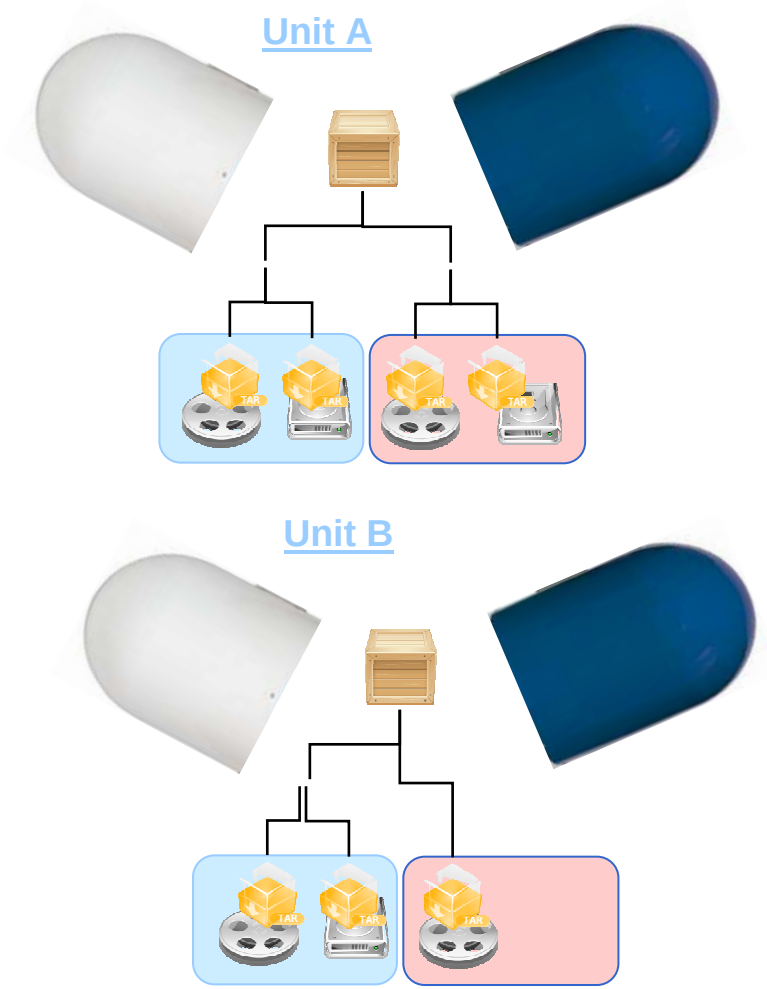
Main concepts for the SAS

• **A record** is a information managed by the SAS. Each record is hosted on one and only one storage unit.

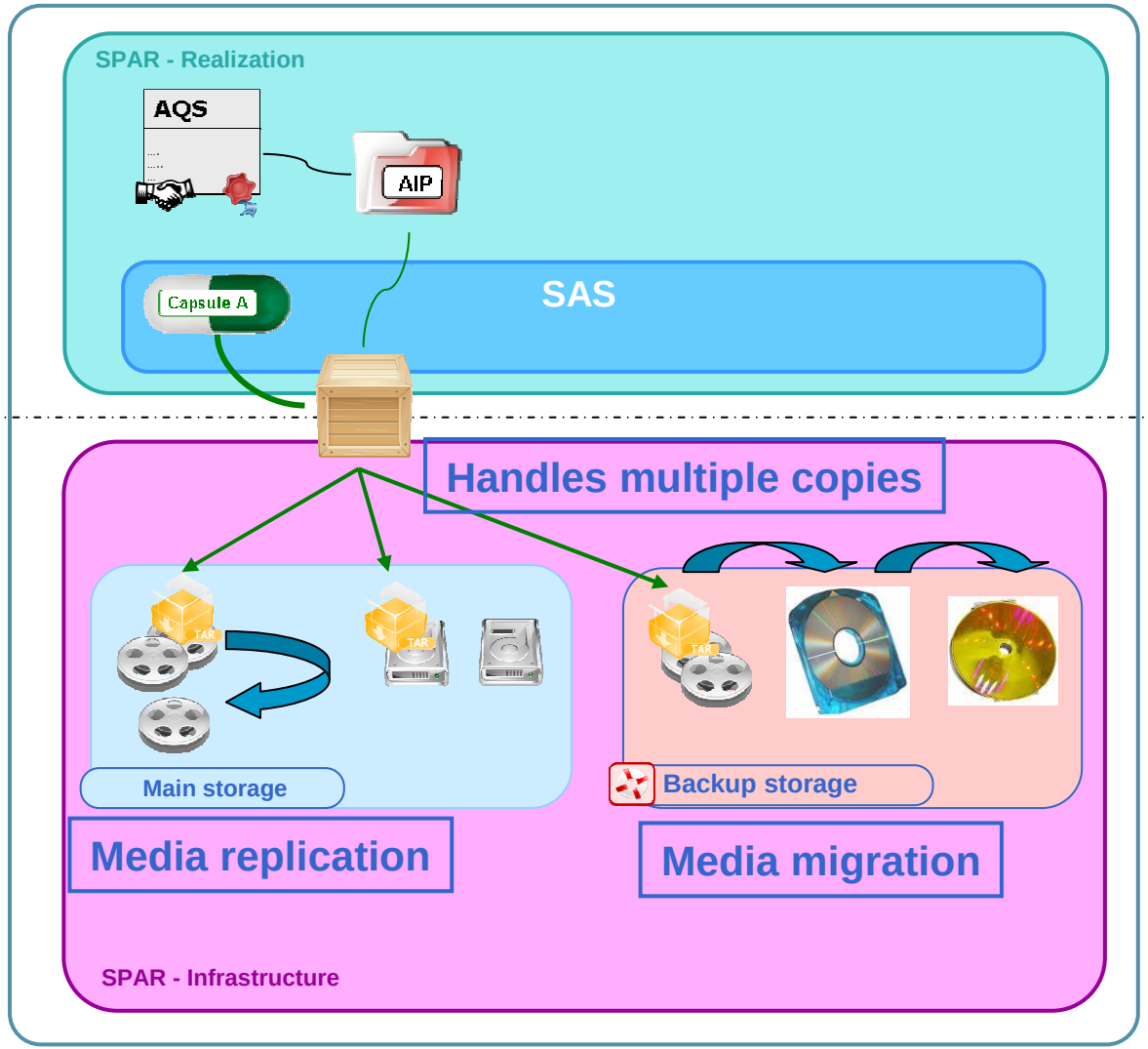
• **A copy (or replica):** Depending on the needs, a record can have multiple copies on the SAS. All copies are strictly identical (integrity control). The SAS only exposes one record with multiple copies. Each copy is written physically in a storage element.

• **A storage unit:** It handles an entity to capture the characteristics of a particular storage. Each unit is declared by an administrator who defines which elements of storage are linked as well as the number of copies. Every record in one storage unit has the same characteristics of storage.

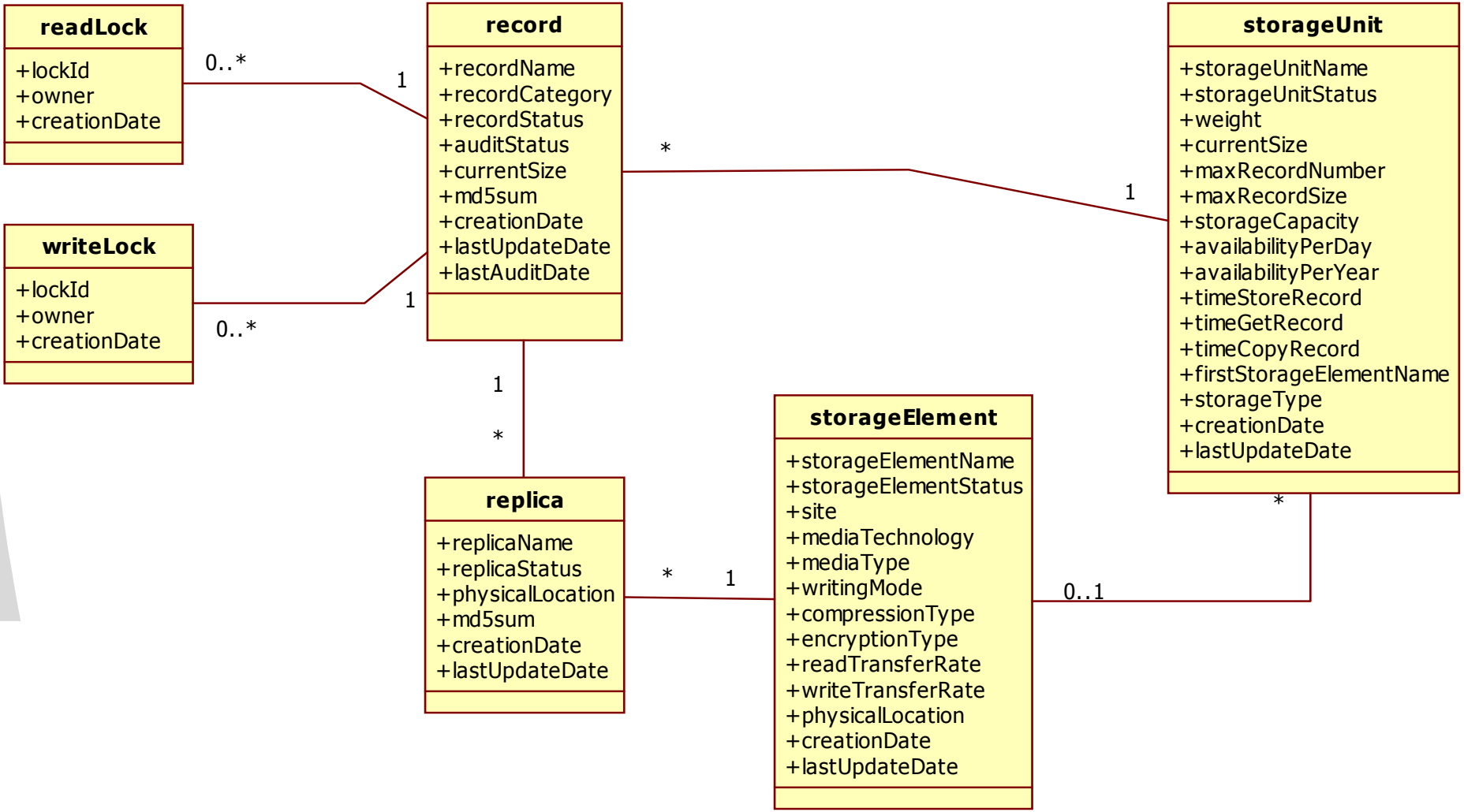
• **A storage element:** it is an entity very closed to the hardware (media, disk, tapes), except that it represents a part of a physical media. For example: a partition of a disk array or a pool of tapes…



Global design



Logical Data Model



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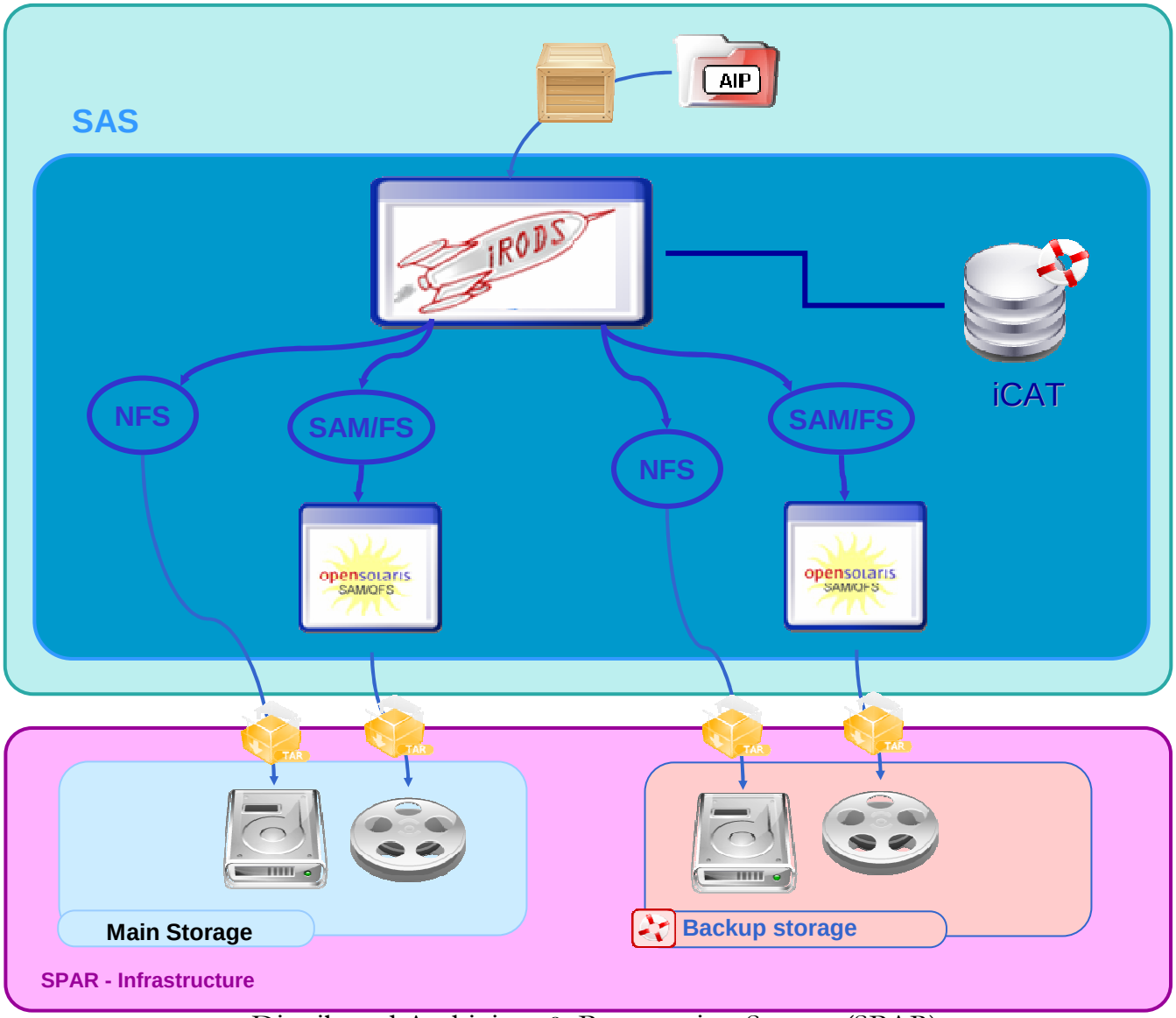
Implementation choice

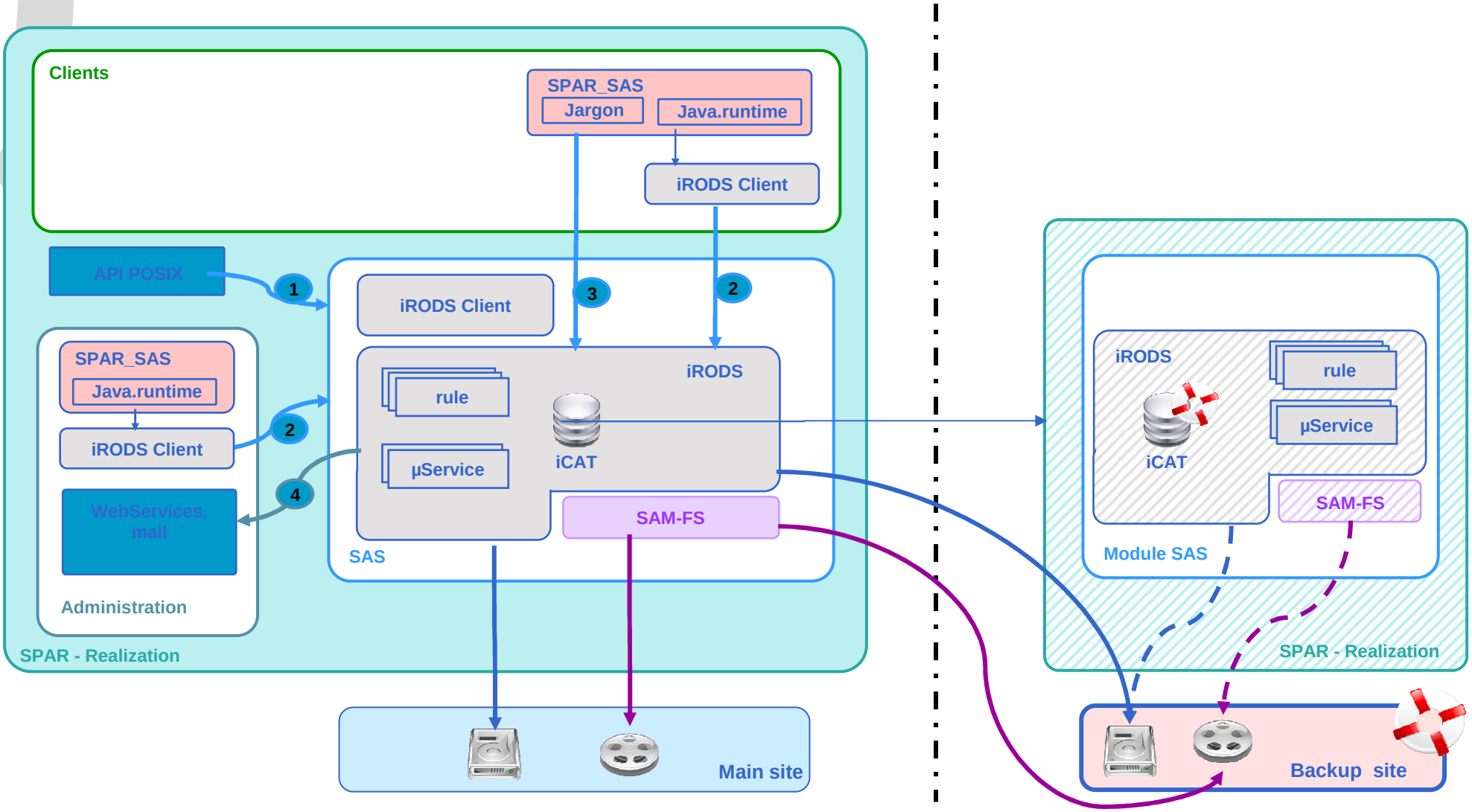
- iRods
  - →scalable and proven
  - →rules based

- Use of the rules to configure a storage unit
  - →rule for put
  - →rule for audit
  - →rule for get
- General rules for
  - →refreshment migration
  - →duplication migration

Technical implementation: iRODS



iRODS : Logical objects ⇔ Physical copies



Dialog between Storage module and SAS

- Storing an AIP
  - corresponding SLA search (storage requirements)
  - retrieval of available storage units with compatible class of service
  - choose of the least expensive storage unit
  - store the AIP as a record
- Audit of an AIP
  - if audit time has expired,
  - asked the SAS for an audit of the copies
  - retrieved the package itself for internal audit
- Retrieve of an AIP
  - get back the first ok copy
  - if one is found bad, launch an audit

Storing an AIP

```
sasPUT(*rodsPath,*localFilePath,*mainResource,*inputChecksum)||
  acObjPutWithDateAndChksumAsAVUs(
    *rodsPath,*mainResource,*localFilePath,
    *inputChecksum,*outstatus)##
  assign(*replicasAttributeCondition,
        RESC_NAME = '*mainResource'
        AND META_RESC_ATTR_NAME = 'replicaResources')##
  acGetValueForResourceMetaAttribute(
    *replicasAttributeCondition,*replList)##
  ifExec(*replList != none,
    forEachExec(*replList,
      writeLine(stdout,"replicating to *replList ")##
      delayExec(<PLUSET>1m</PLUSET>,
        msiDataObjRepl(*rodsPath,*replList,*replStatus),nop),
      nop
    ),
    nop,nop,nop
  )
```

Save replica 1 with checksum test

Query for replica resources

Get the list

Iterate to plan the creation of each replica

Audit an AIP

```
sasAUDIT(*rodsName,*parentColl,*stageDir)||
  assign(*rodsPath,null)##
  acGetFullPathFromDataObjParentCollection(*rodsName,*parentColl,*rodsPath)##
  assign(*locationsCondition,COLL_NAME LIKE '*parentColl/%' AND DATA_NAME ='*rodsName')##
  assign(*storedChecksumCondition,*locationsCondition AND META_DATA_ATTR_NAME ='MD5SUM')##
  acGetValueForDataObjMetaAttribute(*storedChecksumCondition,*objStoredChksum)##
  acGetDataObjLocations(*locationsCondition,*matchingObjects)##
  forEachExec(*matchingObjects,
    msiGetValByKey(*matchingObjects,RESC_LOC,*objReplicaHost),
    msiGetValByKey(*matchingObjects,DATA_PATH,*objPhysicalPath
    msiGetValByKey(*matchingObjects,RESC_NAME,*currRescName)##
    remoteExec(*objReplicaHost,null,
      acGetPhysicalDataObjMD5SUM(*objPhysicalPath,*objReplicaHost,*objPhysicalMD5),nop
    )##
    ifExec(*objStoredChksum == *objPhysicalMD5,
      writeLine(stdout,"input and computed MD5 checksums match")
      acReplaceStaleReplica(*rodsPath,*currRescName,*replStatus)
    ),
    nop
  )##
  writeLine(stdout,"getting  *rodsName to *stageDir/*rodsName")##
  msiDataObjGet(*rodsPath,*stageDir/*rodsName,*getStatus)
```

Retrieve all the replicas

Calculate the checksum

Replace the bad replica

Get a good replica for functional audit

Retrieving an AIP

```
sasGET(*rodsName,*parentColl,*stageDir)||
  assign(*rodsPath,null)##
  acGetFullPathFromDataObjParentCollection(*rodsName,*parentCo
  assign(*locationsCondition,DATA_NAME = '*rodsName')##
  assign(*storedChecksumCondition,*locationsCondi                AND META_                )##
  assign(*goodReplicaEncountered,0)##
  acGetValueForDataObjMetaAttribute(*storedChecksumCondition,*objStoredChksum)##
  acGetDataObjLocations(*locationsCondition,*matchingObjects)##
  forEachExec(*matchingObjects,
    ifExec(*goodReplicaEncountered == 0,
      msiGetValByKey(*matchingObjects,RESC_LOC,*objReplicaHost)##
      msiGetValByKey(*matchingObjects,DATA_PATH,*objPhysicalPath)
      msiGetValByKey(*matchingObjects,RESC_NAME,*currRe                )##
      remoteExec(*objReplicaHost,null,
        acGetPhysicalDataObjMD5SUM(*objPhysicalPath,*objReplicaHost,*objPhysicalMD5),nop)##
      ifExec(*objStoredChksum == *objPhysicalMD5,
        assign(*goodReplicaEncountered,1),nop,
        delayExec(<PLUSET>1m</PLUSET>,
          acReplaceStaleReplica(*rodsPath,*currRescName,*replStatus),nop
        ),nop
      ),nop,nop,nop
    ),nop
  )##
  msiDataObjGet(*rodsPath,*stageDir/*rodsName,*getStatus)
```

No good replica yet found

Calculate the checksum

Plan the replacement of the bad replica

Get the first good replica

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Conclusion

- Goal for the archived objects
  - → definition of an open model
  - → completeness of the description
  - → self-supporting package
- Ways of dealing with the permanency
  - → modularity
  - → abstraction
  - → use of well known formats and standards
  - → use of Open Source technical building blocks

Thank you for your attention

Questions ?

More information : http://bibnum.bnf.fr/spar

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